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REVIEW ARTICLE

A Phenotypic and Genetic Characterized Indigenous Chicken Ecotypes in Ethiopia

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ABSTRACT

Review was conducted in Ethiopia during the year of 2014 to identify phenotypic and genetic characterized indigenous chicken ecotypes in Ethiopia. The data stated that poultry is a name given to domesticated birds kept by humans for eggs, meat and feathers. Thus domesticated poultry species are originated from the genus Gallus domestics. In Ethiopia from poultry species except chickens others are found in their natural habitats. Thus domesticated chickens ecotypes are characterized in both phenotypic and genetic methodologies. Based on phenotype about 17 indigenous chicken ecotypes are identified and characterized. Among phenotypic characterized chickens are Chefe, Jarso, Tilili, Horro, Tepi, Gelila, Debre-Elias, Melo-Hamusit, Gassay, Guangua, Mecha, Farta, Konso, Mandura, Sheka, Naked neck, Gugut and Gasgie. Whereas some of the phenotypic characterized chickens ecotypes are additionally identified their genetic variation using molecular characterization methods such as Debre- Elias, Melo- Hamusit, Tilili, Gassay and Naked Neck. Those indentified chicken ecotypes have their own unique morphological and genetic characteristics. Thus chicken ecotypes are providing important opportunities for increasing protein production and income generating for smallholders having short generation interval and high rate of productivity. Production system of those identified chicken were majorly traditional extensive type. Diseases, predators, lack of market facility, shortage of feed and poor extension service were the major barriers of production system of identified chickens. Generally chicken with different genetic and phenotypic character must be identified to conserve and protect from genetic erosion and dilution.

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INTRODUCTION

Ethiopia takes the lead in livestock populations in Africa and get way of domestic animals migrated from Asia to Africa (CSA, 2011). Bushra (2012) reported that world's chicken population was estimated about 16.2 billion of which 71.6% were found in developing countries which were producing 67, 718, 544 metric tons of chicken meat and 57, 861, 747 metric tons of hen eggs. Whereas in Ethiopia the population was estimated about 49.3 million of which 97.3, 2.32 and 0.38% were indigenous, exotic and hybrid, respectively which were producing 72,300 metric tons of chicken meat and 78,000 metric tons of hen eggs (CSA, 2011). Such poultry species contributed important socio-economic roles for food securities, generating additional cash incomes and religious/cultural reasons (Tadelle, 2003). Due to this reason many of the world's rural poor are depend on chicken production (Solomon, 2007). About 60% of East African identified and characterized chicken population found in Ethiopia which is played a significant role in human nutrition and as a source of cash income (Mekonnen *et al.*, 2007). However, the distribution and density of chickens are varying from place to place and found in most parts of the country suitable for human settlement. Still these large populated indigenous chickens are found in extensive production system (Addis *et al.*, 2014). Those indigenous chickens are characterized by poor in performances than exotic chickens (Bogale, 2008). There is no well developed breeding practice of chicken production in Ethiopia. However, farmers follow their own breeding practice through selection based on some criteria to increase meat and egg production (Halima, 2007; Bogale, 2008; Fisseha *et al.*, 2010b). Tadelle (1996)

reported that in the central high lands of Ethiopia, introduction of exotic breeds were practiced. Nevertheless, their effects on upgrading of the village chicken performances have been minimal. This is because the programs were planned without participation of farmers, with no parallel improvement of feeding, housing and health care (Tadelle, 1996 and Bogale, 2008). To improve the performance of indigenous chicken identification of available genetic resource is important (FAO, 2011). Some researchers (Tadelle, 2003; Halima, 2007; Nigussie *et al*., 2010) have made both phenotypic and genetic characterization of indigenous chicken ecotypes in some parts of Ethiopia. The above mentioned authors were put their document in a separate and unorganized form. So comprehensive documentation of chicken genetic resources in general, describing local chicken types, constraints and variations in particular was mandatory for the review. Therefore, this review was carried out to identify phenotypically and genetically identified and characterized chicken ecotypes in Ethiopia.

Origin and domestication of chickens

The review revealed that the domesticated chicken (*Gallus Gallus*, 2n = 78) is believed to be descended from the wild Indian and Southeast Asian red jungle fowl (Halima, 2007). The evolutionary history of the domestic fowl development was characterized in to three most known phases. The first phase is started with the evolution of the genus Gallus, the second emergence of the domestic fowl from its progenitors and lastly the appearance of the large number of the current breeds, varieties, strains and lines (Addis *et al*., 2014). The domestication of fowl in the region of the Indus valley is believed to have occurred by 2000 BC (Duguma, 2006), but more recent archaeological evidences showed that a much earlier domestication occurred in China 6000 BC (Aklilu, 2007). Four species of Gallus have been considered as progenitors of the domesticated fowls were *Gallus Gallus* (Red jungle fowl), *Gallus Lafayette* (Ceylon jungle fowl), *Gallus sonnerrati* (Grey jungle fowl) and *Gallus varius* (Green jungle fowl) and all found in regions of Southeast Asia (Halima, 2007). The red jungle fowl is one of the oldest domesticated birds and its popularity quickly spread to Europe. Oddly enough, its original popularity till the beginning of the 19th century was not for meat but for game of cockfighting and use in religious rituals (Negussie, 2011). The utilization of poultry for meat and eggs came into picture during the 20th century when the poultry industry developed as a commercial industry (Halima, 2007).

Phenotypically characterized indigenous chicken ecotypes

Phenotypic characterization is a systematic documentation of the distinct qualitative and quantitative nature of an animal with their production environment (FAO, 2011). Therefore based on the concept of phenotype characterization, most scientists stated that Ethiopian indigenous chickens are none descriptive type and they are closely related to the red Jungle fowl and vary in plumage color, comb type, body conformation and weight (Halima, 2007). They are characterized by slow growth rate, late sexual maturity and low production as well as reproductive performance (Meseret, 2010). In Ethiopia, limited attention has been given to local chicken to identification and characterization the available genetic resources of non-descriptive chicken ecotypes and now researchers done their researches at its basic stage for the recognition and conservation (Halima, 2007). Because of their large population size and wide distribution, only small portion of Ethiopian indigenous chicken are identified and characterized (Nigussie, 2011; Halima, 2007; Tadelle, 2003 and Bogale, 2008). Those identified chickens are taken their name based on their niches like, *Chefe, Jarso, Tilili, Horro* and *Tepi* (Tadelle *et al*., 2003), *Gelila, Debre-Elias, Melo-Hamusit, Gassay, Tilili, Horro, Guangua* and *Mecha* (Halima, 2007) and *Farta, Konso, Mandura* ,*Horro* and *Sheka* (Nigussie, 2011) and based on their plumage color the indigenous chicken ecotypes named as *Tikur*, *Key*, *Gebsima*, *Netch*, *Serrano, Libework*, *Teterma*, *Tikur-Teterma* and *Key -Teterma* (Bogale, 2008) were the major chicken ecotypes found in different part of Ethiopia (Table 1).

Molecular characterized indigenous chicken ecotypes

Basically Ethiopian indigenous chickens ecotypes are not well characterized genetically but not more than two researchers were conducted their research in molecular characterization of indigenous chicken. Among those (Halima, 2007) was characterized *Tilili, Melo-Hamusit, Debere-Elias* and *Gassy* with the title of phenotypic and genetic characterization of indigenous chicken populations in Northwest Ethiopia and (Tadelle, 2003) was characterized Naked Neck (Melata) in Ethiopia in the title of phenotypic and genetic characterization of local chicken ecotypes in Ethiopia. In contrast to using morphological traits and/or measurements for characterization, DNA-based methods are independent of environmental factors and provide useful information about genetic diversity (Halima, 2007). This holds particularly true for DNA-profiling methods, which is based on the polymerase Chain Reaction (PCR) and microsatellite markers (Tadelle, 2003 and Halima, 2007). Microsatellites have been used in a number of studies to address the biodiversity in commercial as well as rare breeds. Microsatellites are stretches of DNA that consist of variable number tandem repeats (VNTRs) of a simple sequence of nucleotides or loci (2 to 4 bases). Simple tandem repeats exhibit a Considerable degree of polymorphism in the genome of many eukaryotic cells (Tadelle, 2003) and are dispersed in the entire genome. The basic units of the simple tandem repeats consist of small numbers of base pairs (i.e. CAC, GATA, GACA etc. The PCR technique is a primer extension reaction for amplifying specific nucleic acids in vitro (Besbes, 2009). The sources of DNA used in PCR reaction can be genomic DNA from whole blood or tissue, or forensic specimens and ancient biological sample. PCR is a powerful technique that allows amplifying DNA sequence millions of times in just a few hours (Meseret M, 2010). From the above real world Halima (2007) was used tools such as PCR machine, restriction endonucleatase enzymes (DNA based markers) for molecular characterization of local chicken ecotypes of *Debre-Elias, Melo-Hamusit, Tilili* and *Gassay* whereas (Tadelle, 2003) was used Tools such as Genetic markers (restriction fragment length,

Table 1: The Phenotypically identified and characterized local chicken ecotypes

Identified Ecotypes	Peculiar feature	Dominant location	Reference
Jarso	Red plumage color, no black eye color.	East Hararghe zone	Eskindier *et al*., 2013: Tadelle *et al*., 2003
Tepi	Naked neck, black eye, single combed red skin	Tepi	Tadelle *et al*., 2003
Tilili	Pea comb, lack of shank feather.	West Gojjam zone	Halima, 2007
Gelila	Plain head, pea comb, yellow shank color, lack of shank feather.	West Gojjam zone	Halima, 2007
D/Elias	Plain head, pea comp, and v-shaped comb, do not have shank feather	East Gojjam zone	Halima, 2007
M/Hamusit	Crest head shape, all ecotypes (57%) pea except strawberry, lack of shank feather yellow shank color.	South Gondar zone	Halima, 2007
Gassay	Crest head shape, all ecotypes (57%) pea except strawberry, lack of shank feather yellow shank color.	South Gondar zone	Halima, 2007
Guangua	Crest and plain head, pea comp, no shank feather, yellow shank	Agew Awi zone	Halima, 2007
Mecha	Plain and crest head shape, pea comp	West Gojjam zone	Halima, 2007
Horro	Flat head shape, pea comb type, blocky body yellow shank color.	East Welega zone	Negussie, 2011and Halima, 2007
Farta	Crest head shape, pea comp type. Blocky body shape and yellow shank	South Gondar zone	Halima, 2007and Negussie, 2011
Konso	Flat head shape, pea comb type, blocky body shape, yellow shank	SNNP region	Negussie, 2011
Sheka	Flat head, pea comb, blocky body shape, yellow shank color.	SNNP region	Negussie, 2011
Mandura	Crest head, pea comb type, blocky body type and yellow shank color.	Amahara, Gumuz, Agew and Oromia	Negussie, 2011 and Halima, 2007
Gugut	muffed, absent of wattle in hen	Tache Armacheho	Addis *et al*.,2014
Gasgie	Long necked and red in color	Alefa	Addis *et al*.,2014
Nacked Neck	Aggressive, absent of feather at neck	Quara	Addis *et al*.,2014

Table 2: The molecular characterized chicken ecotype in Ethiopia

Ecotypes	Number of allele per locus	Reference	Methods used for genetic characterization
Debere-Elias	6.29	Halima, 2007	PCR
Melo-Hamusit	6		DNA extraction
Tilili	5.57		Gel electrophoresis
Gassay	10		Microsatellite marker
Naked Neck		Tadelle, 2003	Not specified

Table 3: Performance of Indigenous Chicken Ecotypes

Traits	Performance	Reference	Study site
Aafe	217 days	Fassil *et a.*, 2010	HUCA
Aafsm	169 days	Solomon, 2007	South Ethiopia
Egg/year	45	Kidane,1986	WADU
Egg/year	34	Brannang and Pearson, 1990	Asella
	37.5	Halima, 2007	North west Ethiopia
	56.5	Fisseha *et al*., 2010b	Ethiopia
Egg/cultch	12-13 egg/clutch	Bogale, 2008	Fogera District
Hatchability %	82.83	Fisseha, 2010a	Bure District
Fertility %	78.6	Fisseha, 2010a	Bure District

microsatellite marker, restriction endonucleatase enzymes, heat-stable DNA Polymerase enzyme and PCR machine for molecular characterization of local chicken ecotypes Naked Neck (Table 2).

Performances of the characterized chicken ecotypes

Diverse environmental conditions and different cultural orientations have contributed to the observed genetic variations of chickens (Besbes, 2009). In Ethiopia many researchers reveled that performances of indigenous chickens are well adapted to the tropics, resistant to poor management, feed shortages, tolerate to diseases and provide better test of meat and eggs than exotic chicken (Tadelle and Ogle, 2001). However, they are poor performance in terms of egg size, slow growth rate, late maturity and slow age at first mating, small clutch size and hatchability (Bogale, 2008; Fisseha, 2009; Meseret, 2010). Various reports in different site showed that the quantitative traits performance of local chickens is varied because of genotype (additive and dominant) and environmental effect which produced 30 to 60 eggs/hen/ year (Kidane, 1986) at (WADU), 34 eggs/hen/year (Brannang and Pearson, 1990) at Asella, 18-57 eggs/year/ hen (Halima, 2007) at Northwest Amhara,12-13egg/cultch (Bogale, 2008) at Fogera, 10.05±0.15egg/cultch (Fisseha, 2009) at Bure and the other recent study reported that local chicken eggs laid ranges from 53-60 egg/hen/year (Fisseha *et al.,* 2010a) at North-West Ethiopia. Therefore local chickens need relatively less environmental modification and highly genetic improvement to achieve increased productivity (Fisseha *et al*., 2010a).

Major causes of variation and identification methods of characterized chicken

Causes of variation is typically generated from genetically and environmentally variation between populations including number of factors involved as natural and managemental aspect considering artificial selection, mutation, migration, and non-random mating (Halima, 2007). While breeding domesticated animals, man has strongly forced the accumulation of genetic differences between breeds and populations by isolating and selecting them for favorable traits. Therefore, to set up efficient conservation and utilization measures reliable information about genetic differences between individuals, populations and breeds are required. Quantitative assessment of genetic diversity within and among populations is an important tool for decision making in genetic conservation and utilization plans (Tadelle, 2003). The most widely used method to quantify these genetic diversities is utilizing phenotypic characters

(morphological) and molecular markers (Tadelle, 2003 and Halima, 2007). The variation is adjusted by phenotypic markers as cheap and easy to apply but they are subjected to environmental influences due to the nature of the qualitative and quantitative traits to be considered (Halima, 2007). Similarly, protein polymorphisms/ biochemical markers have been applied to estimate the genetic variation within and among chicken populations (Nigussie, 2011).The diversity of the local chickens that are reported mostly on phenotypes including adult bodyweight, egg weight, reproduction performance and immune responses to various diseases (Tadelle,2003and Halima, 2007). Limited reports have addressed the genetic diversity of the indigenous chickens (Tadelle *et al.,* 2003) with the primary aim to understand the extent of genetic variation within and among population

Characterized chickens and its production systems

The rural poultry population in most African countries accounts for more than 60 percent of the total national poultry population (Sonaiya, 1997). However, inadequate attention has been given to evaluate these resources or to set up realistic and optimum breeding goals for their improvement. As a result some of the animal genetic resources of Africa are endangered, unless urgent efforts are taken to characterize and conserve (Nigussie, 2011). The majority of livestock genetic diversity is found in the developing world where documentation is scarce and risk of extinction is highest and increasing. Particularly, it is estimated that 35% of mammalian breeds and 63% of avian breeds are at risk of extinction (FAO, 2011). In Ethiopia poultry production systems show a clear distinction between the traditional, low input system on the one side and modern production systems using relatively advanced technology on the other hand (Messeret,2010). The traditional poultry production system comprises of those indigenous chickens and characterized by small flock size, low input and output and periodic devastation of the flock by disease (Mammon and Wudu, 2011) .There is no separate poultry house and the chickens live in family dwellings together with human beings, there is no purposeful feeding of chickens and scavenging is almost the only source of diet and there is no designed selection and controlled breeding (Tadelle, 1996). The successes of the hatching and brooding process depends on the maternal instinct of the broody hen and prevalence of predators in the area, such as birds of prey, pets and some wild animals, all of which are listed as the major causes of premature death of chicks in Ethiopia (Solomon, 2007).

Opportunities of chicken production

Indigenous chickens provide major opportunities for increased protein production and income for smallholders (Sonaiya, 1997). Chickens have a short generation interval and a high rate of productivity. They can also be transported with ease to different areas and are relatively affordable and consumed by the rural poor people as compared with other farm animals such as cattle and small ruminants (Bogale, 2008). Chickens also play a complementary role in relation to other crop livestock activities. Indigenous chickens are good scavengers as well as foragers and have high levels of disease tolerance, possess good maternal qualities and are adapted to harsh conditions and poor quality feeds as compared to the exotic breeds (Halima, 2007).

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Major challenges

Reported challenges during characterization were Prevalence of disease, lack of proper housing system and predation (Halima,2007).The main causes of chicken death were seasonal outbreaks of diseases, mainly Newcastle disease (Bogale, 2008). In addition to Newcastle diseases, coccidiosis and fowl typhoid are the major cause for chicken mortality (Mekonnen, 2007; Bogale, 2008) followed by predator (Halima, 2007). Village chicken production in Ethiopia characterized by lack of separate house prepare for their chicken (Halima, 2007; Bogale, 2008; Fisseha, 2009; Fisseha *et al.,* 2010b). This exposes the chicken to predator and infectious diseases (Bogale, 2008. Predations were the major constraints in village chicken production (Halima, 2007; Mekonnen, 2007; Fisseha *et al.,* 2010a). Wild birds (chilfit) were the first major and dangerous types of predators followed by "Aner" and wild cat (Fisseha, 2009).

Management system and feeding

Productive performance of village chickens was relatively low because of genetic and non-genetic factors (Bogale, 2008). Production losses due to poor chicken management (feeding, housing and health care) were disclosed in Bure district (Fisseha, 2009). The nutritional status of local laying hens from chemical analysis of crop contents indicated that protein was below the requirement for optimum egg production (Halima, 2007). The deficiency is more series during the short rainy season and dry seasons (Alemu and Tadelle, 1997).

Market system

The price of live chickens and eggs fluctuate seasonally, more demand on holidays and at the end of fasting seasons at that time the price increase (Halima, 2007; Mekonnen, 2007). In human methods of transporting chicken and egg to market create physical injury and other complications on the chickens and eggs that reduce the quality of products (Bogale, 2008).

Conclusion and recommendation

Generally the Ethiopian identified chicken ecotypes are originated from red jangle fowl from south East Asia. Small portion of chicken ecotypes identified and characterized. Among those chicken ecotypes *Tilili, Tepi, Jarso, Gelila, Debre-Elias, Melo- Hamusit, Gassy, Guangua, Mecha, Horro, Farta, Konso, Sheka, Mandura, Gugut, Gasgie* and *Naked Neck* are Phenotypically identified chicken ecotypes in Amhara, SNNP, Oromia and Binishangule Gumuz region. Whereas molecular characterized chicken ecotypes are *Debere-Elias, Melo-Hamusit, Gassay, Tilili* and *Naked Neck*. Those identified chicken ecotypes show a large variation in body position, plumage color, comb type and productivity. Increased protein production and income of smallholders is the most important opportunities of the characterized chicken ecotypes production. Prevalence of disease, lack of proper housing system and predation were the main constants of

production. Finally the present review investigation was recommended the following important points:

- ✓ Further research should be done to show diversity of phenotypic and genetic characters within and between the Ethiopian chicken ecotypes.
- ✓ Phenotypic characterization of indigenous chicken should be supported by genetic characterization methods.
- ✓ Access of market for those indigenous chickens should be emphasized.
- ✓ Protection of those chickens from genetic dilution and erosion should be emphasized.

Training for both farmers and extension staff focusing on disease control, improved housing, and feeding, marketing system should be performed.

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